Hydrogeological model of Latvia LAMO

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on possible application of LAMO data for the Plavinu HPS area

Location of LAMO

In 2010 – 2012, the hydrogeological model (HM) of Latvia (LAMO) has been developed by scientists of Riga Technical University (RTU). LAMO generalizes geological and hydrogeological information accumulated by the Latvian Environment, Geology and Meteorology Centre.

The commercial program Groundwater Vistas-6 (GV) is used for running LAMO. The GV system contains wordly used programs MODFLOW (supports HM), MODPATH (particle tracking), MTeD (mass transport modelling)..

Versions of LAMO

In 2013 – 2015, LAMO was considerably upgraded.

The work was supported by the
National Research Program «EVIDEnT».

Name of version	Year of dispose	Approximation grid			Rivers in model			Lakes
		Plane step [meter]	Number of grid planes	Number of cells [$\times 10^6$]	Number	Valleys incised	Flow data used	Number
LAMO1	2012	500	25	14.25	199	no	no	67
LAMO2	2013	500	27	15.43	199	yes	no	67
LAMO3	2014	500	27	15.43	469	yes	no	127
LAMO4	2015	250	27	61.56	469	yes	yes	127

Vertical schematization of LAMO4

By applying 3D-finite difference approximation, the *xyz*–grid of HM is built using ($h \times h \times m$) sized bocks (*h* is block plane size, *m* is the variable thickness of a geological layer). The model constitutes a rectangular *p*–tiered *xy*–layer system where *p* is the number of geological layers. For LAMO, *p*=27, *h*=250 metres. The 3D body of LAMO is approximated by the xyz–grid of size 1901×1201×27.

No of HM layer	*	Name of layer	HM layer code	Area, [thous. km^2]	m_{mean}, [meter]	k_{mean} [meter /day]
1		Relief	relh	71.29	0.02	10.0
2		Aeration zone	aer	71.29	0.02	3.1×10^{-6}
3		Unconfined Quaternary	Q2	71.29	5.77	11.2
4		Upper moraine	gQ2z	71.29	22.20	1.4×10^{-3}
5		Confined Quaternary	Q1#	7.4	6.13	7.0
6		Lower moraine	gQ1#z	9.7	9.3	2.8×10^{-4}
7		Ketleru	D3ktl#	5.32	61.46	4.2
8		Ketleru	D3ktlz	5.79	10.52	2.8×10^{-4}
9		Zagares	D3zg#	7.43	42.65	7.0
10		Akmenes	D3akz	7.95	11.05	2.8×10^{-5}
11		Kursas	D3krs#	9.34	22.34	6.3
12		Elejas	D3el#z	9.24	27.58	2.8×10^{-5}
13		Daugavas	D3dg#	32.14	30.37	9.4
14		Salaspils	D3slp#z	35.78	12.67	8.4×10^{-4}
15		Plavinu	D3pl	43.80	22.76	8.6
16		Amatas	D3am#z	45.14	8.97	1.4×10^{-4}
17		Amatas	D3am	46.21	21.91	6.4
18		Upper Gauja	D3gj2z	48.80	11.62	2.8×10^{-4}
19		Upper Gauja	D3gj2	50.92	26.34	6.2
20		Lower Gauja	D3gj1z	53.11	13.17	2.8×10^{-4}
21		Lower Gauja	D3gj1	56.13	31.55	5.4
22		Burtnieku	D2brtz	58.09	15.41	5.6×10^{-4}
23		Burtnieku	D2brt	68.74	45.02	4.2
24		Arikula	D2arz	68.74	15.02	4.2×10^{-4}
25		Arikula	D2ar	68.74	40.03	3.2
26		Narva	D2nr#z	71.29	116.67	2.8×10^{-5}
27		Pernava	D2pr	71.29	25.00	10.0

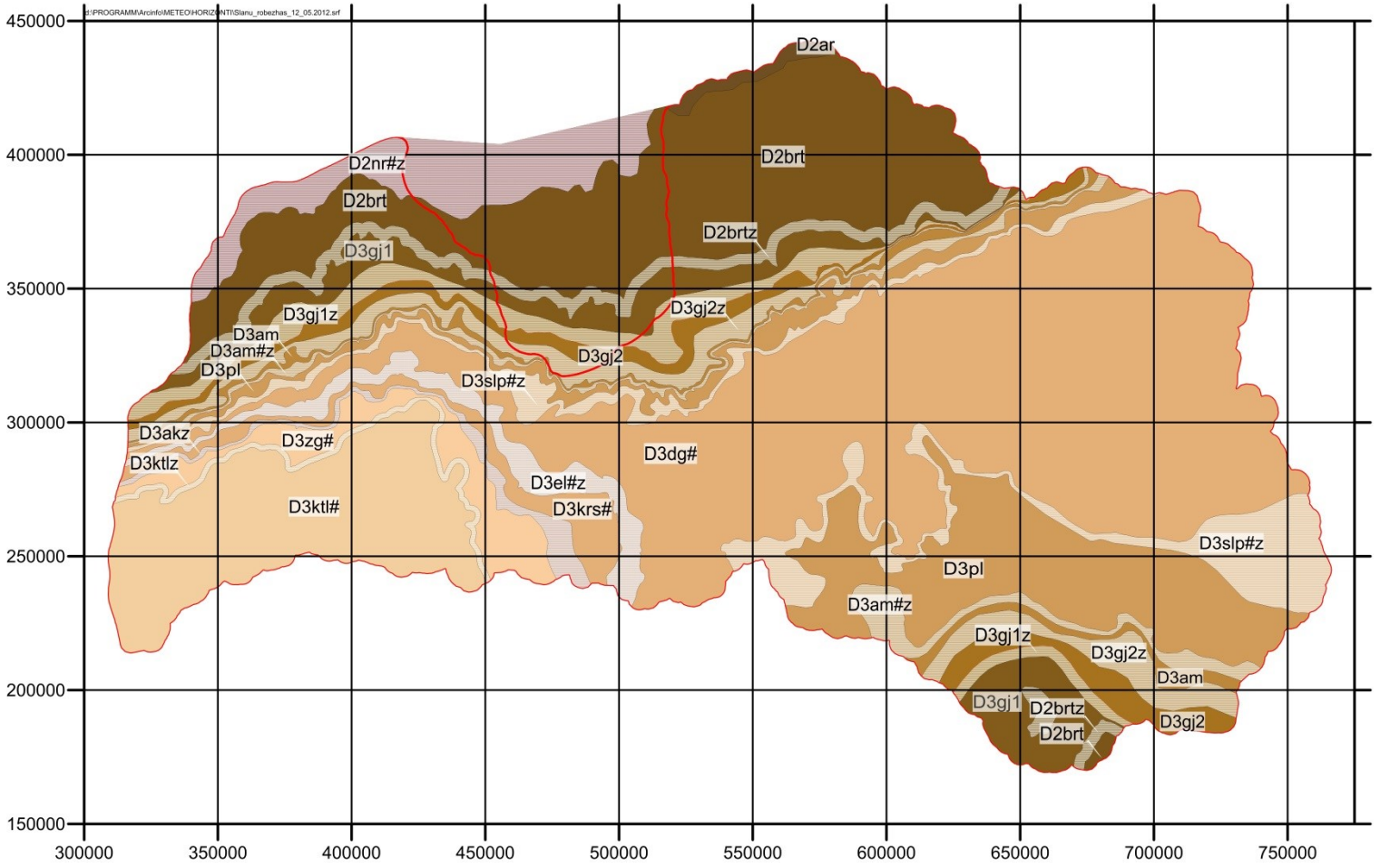
* - aquitard

m_{mean} and k_{mean} – the mean thickness and permeability

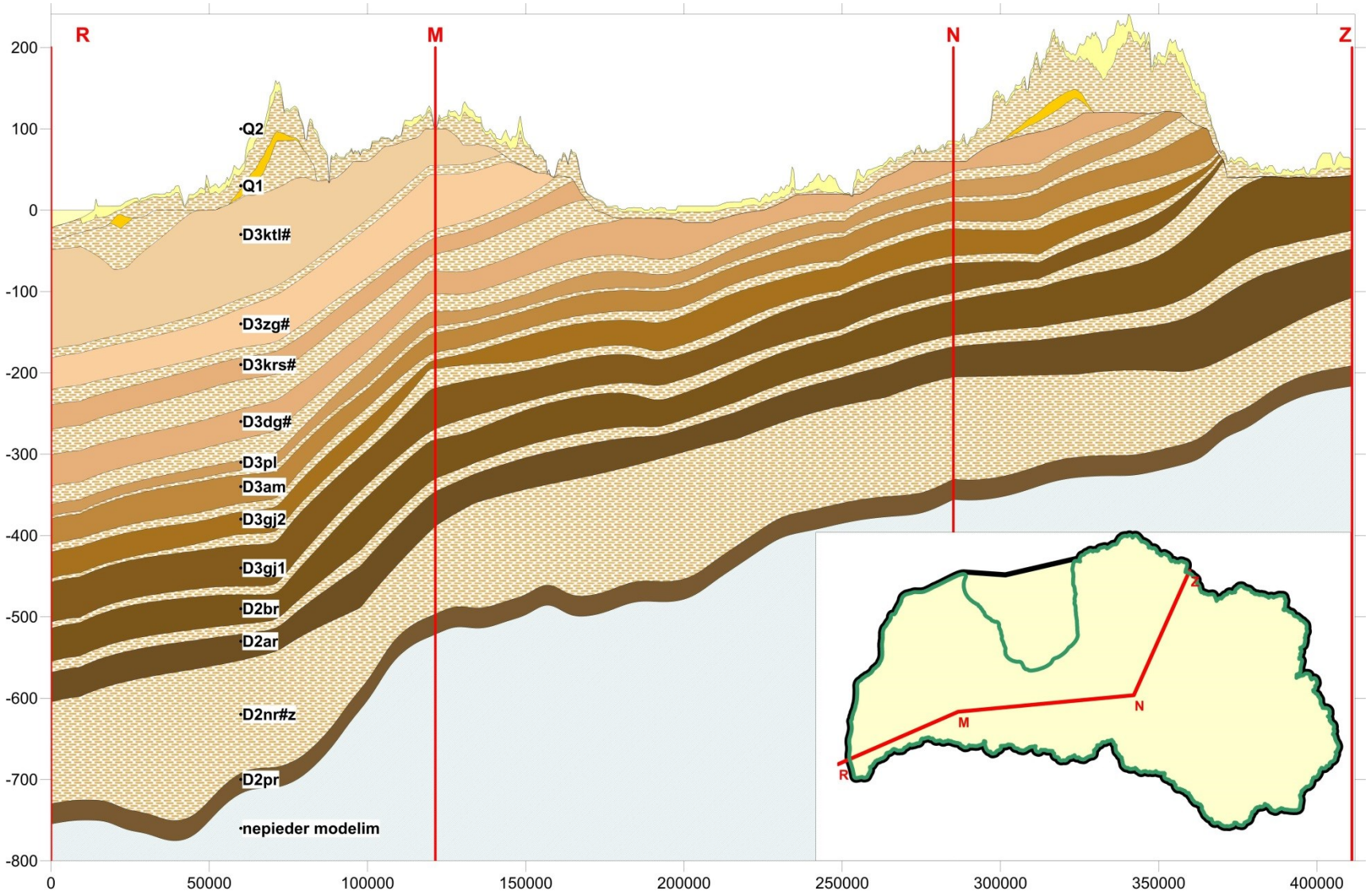
Geological environment of Latvia is very complex, because layers outcrop on subquaternaru surface and are discontinous.

This feature is explained on the slides for boundaries of primary strata and for the geological cross section R_M_N_Z.

Boundaries of primary geological strata



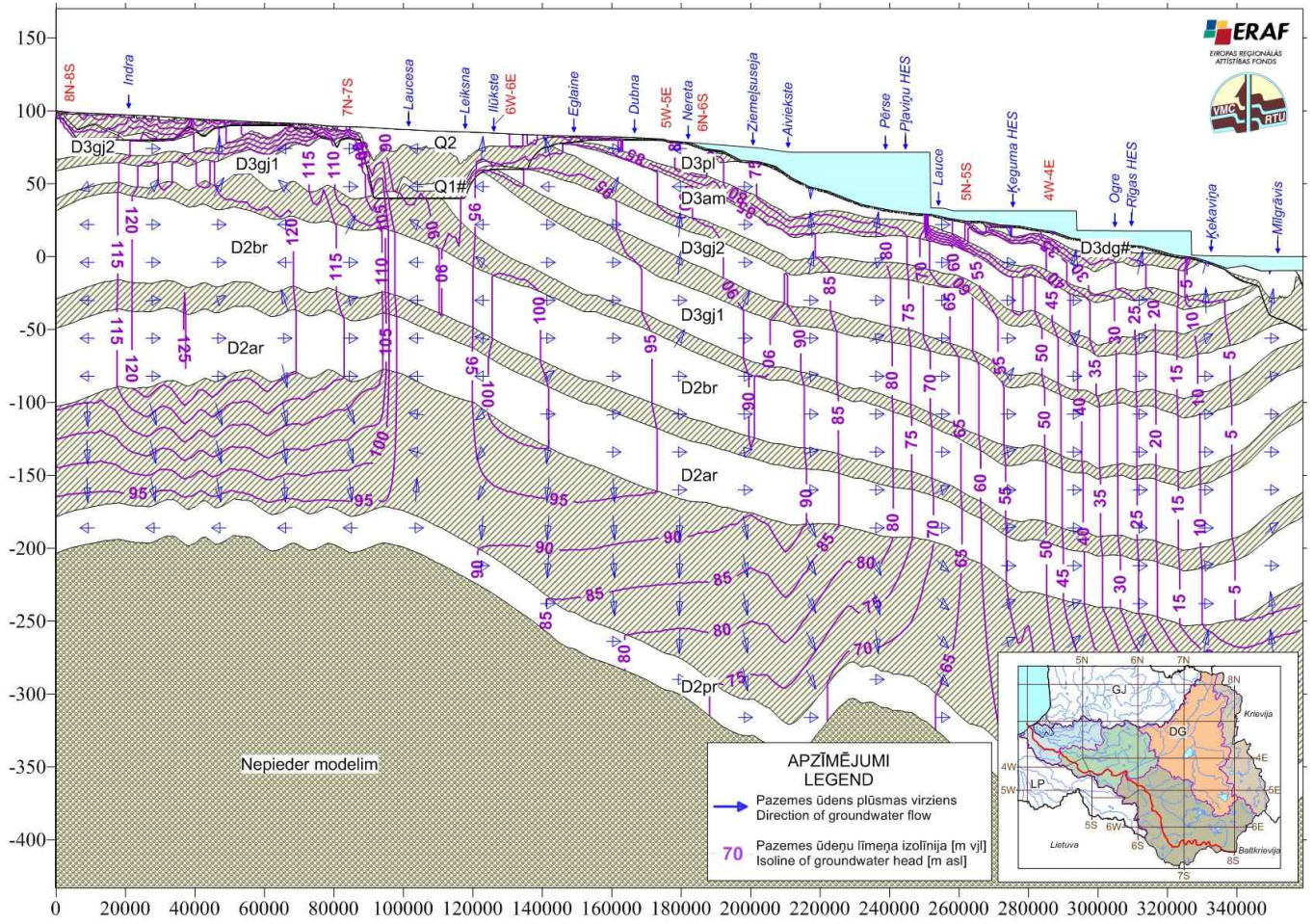
Geological cross section R_M_N_Z



- Geological cross sections can simultaneously carry data on stratigraphy and on distributions of groundwater head and infiltration flow.
- The section along Daugava river crosses the Plavinu HPS area.
- The section 2W_2E touches the northern side of the area

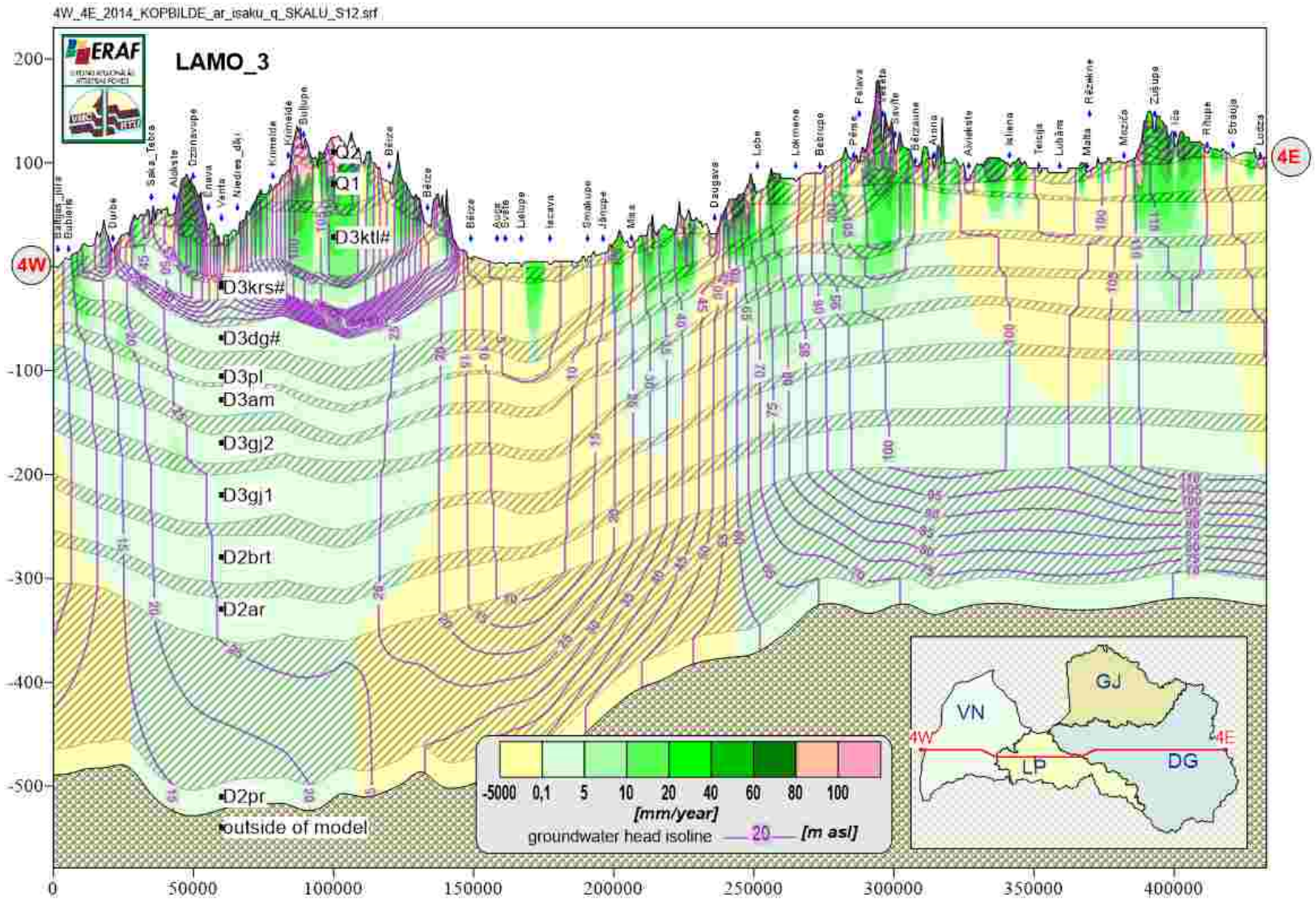
Cross section along Daugava river

stratigraphy of layers and isolines of groundwater head [m asl] are shown



Cross section 2W-2E

Infiltration flow in colour and head distribution isolines

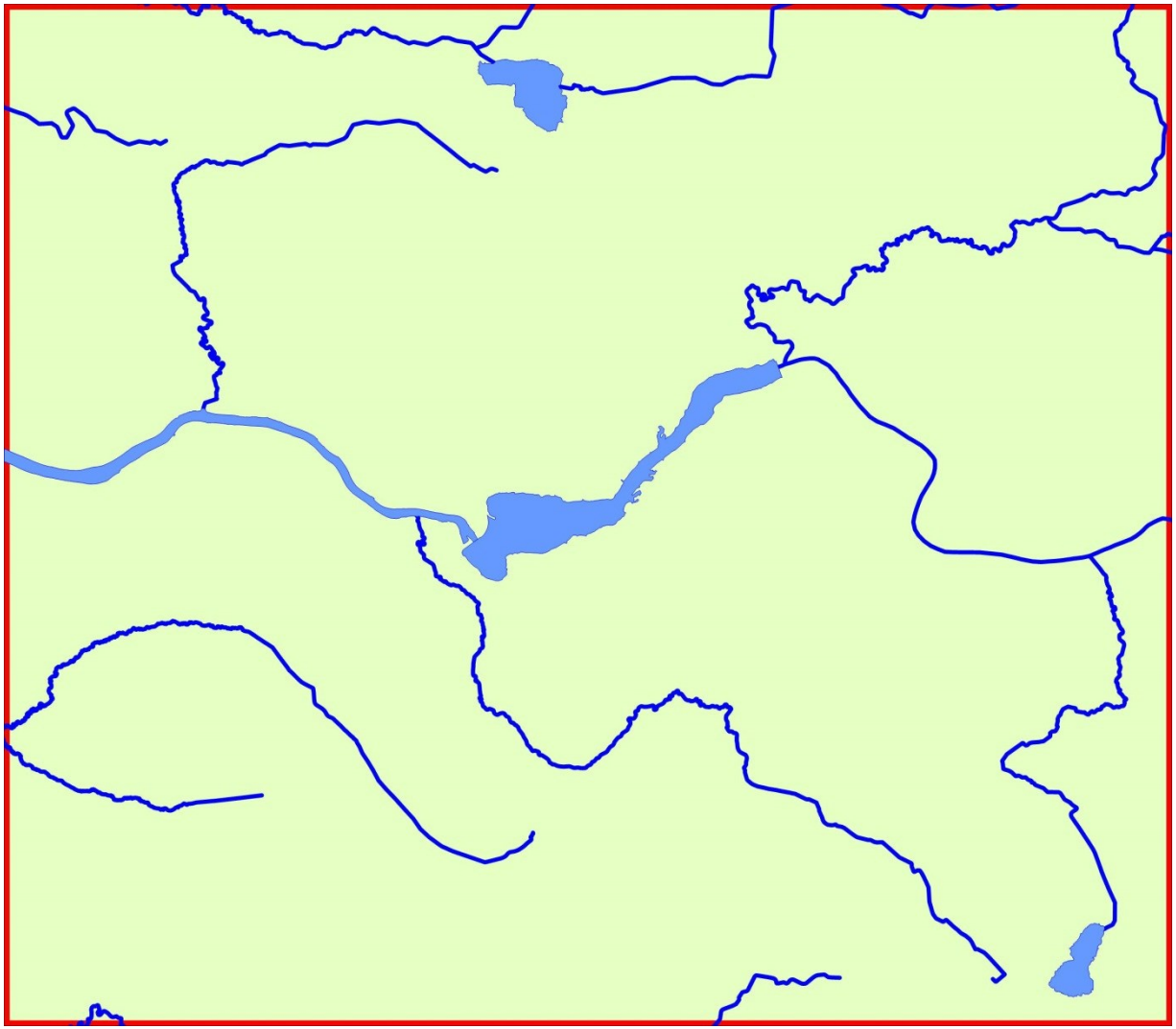


In 2014, number of rivers and lakes was increased

Rivers and lakes of LAMO2 (blue color)
and the new ones of LAMO3 (red color)

Lakes and rivers of LAMO4

Rivers and lakes within Plavinas HPS area



In 2015, the following updates resulted in LAMO4:

- The plane approximation step of HM was reduced from 500 metre to 250 metre.
- To improve transmissivity data of HM primary aquifers, information provided by pumping tests for wells was used.
- The river base flow of HM has been calibrated by using data provided by measurements of river streams

The current LAMO4 version provides the following digital data:

- stratigraphy of geological layers and of their permeability distributions;
- maps of groundwater head and flow distributions;
- information on interaction between groundwater bodies and surface water sources (sea, lakes, rivers, precipitation).

The model serves as the base for creating more detailed local HM.

The model is being applied for investigation of the nature processes for groundwater system of Latvia.

The text of presentation is available on http://www.emc.rtu.lv/VPP/LAMO-Plavinas.pdf

The more detailed current information on LAMO4 is available on http://www.emc.rtu.lv/issues/2016/Spalvins_zin_darbiba.pdf

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Thank you for attention